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09/603,118	06/22/2000	Koichi Nitta	KYOW-900-(US)	9026

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EXAMINER

LOUIE, WAI SING

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 01/02/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/603,118

Applicant(s)

NITTA ET AL.

Examiner

Wai-Sing Louie

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 11 October 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,5,6,8-12,17 and 20-27 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,5,6,8-12,17 and 20-27 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_ 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, and 9-12 are rejected under 35 U.S.C. 102(b) as being anticipated by Schetzina (US 5,351,255).

With regard to claim 1, Schetzina discloses a semiconductor light-emitting device (col. 9, line 9 to col. 24, line 8 and fig. 26) comprising:

- A substrate 103;
- An electrode 104 of one conductivity type, which is formed on the substrate 103;
- An intermediate layer 106, formed on the electrode 104 of the one conductivity type, is a solder material (col. 19, lines 12-15), which inherently contains Ag;
- A reflective layer 13 which is formed on the intermediate layer 106, contains a metal, and reflects light (col. 19, lines 4-6);
- A light-emitting layer 101 formed on the reflective layer to emit light, having a double-heterostructure in which an active layer 101 is sandwiched between first and second cladding layers 16 and 17;
- A transparent electrode 102 formed the light-emitting layer.

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With regard to claim 9, Schetzina discloses the transparent electrode 102 is formed of ITO (col. 18, lines 44-45).

With regard to claim 10, Schetzina discloses the substrate contains a metal (col. 19, lines 9-11).

With regard to claim 11, Schetzina discloses the first and second cladding layers 16 and 17 are set bandgap larger than a bandgap of the active layer 101 (fig. 16a and 17).

With regard to claim 12, Schetzina discloses the active layer 101 could be single or multiple quantum well structure including a well layer and a barrier layer (col. 18, lines 32-38 and fig. 16a-p).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 5 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255).

With regard to claim 5, Schetzina discloses a contact layer 18 of the one conductivity type (col. 11, lines 40-42) and a graded layer 19 having uniform ratio of zinc to mercury (col. 11, lines 43-46) and providing a linear graded doping to match the doping concentration of the cladding layer 17 (col. 11, lines 60-63 and fig. 14). Although, Schetzina does not name this layer

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as a strain-relaxing layer, however, layer 19 is functioned as a strain-relaxing layer. Layer 19 is formed between the reflective layer 13 and the light-emitting layer 101, where layer 19 has a middle band GaP between the contact layer and the cladding layer 17 (fig. 14).

With regard to claim 8, Schetzina discloses the first ohmic electrode 13 is of ITO, which is a known transparent material (col. 12, lines 43-46) and a metal electrode 104 (col. 19, lines 6-7) forming a two-layered structure.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) in view of Biing-Jye et al. (US 6,169,294).

With regard to claim 6, Schetzina discloses a contact layer 16 of opposite conductivity type formed between the light-emitting layer 101 and the transparent electrode 102, but Schetzina does not disclose the layer 16 contains InGaP or InGaAlP. However, Schetzina discloses a Group II-VI light-emitting structure and Schetzina also discloses the structure could be made of Group III-V compound (col. 22, lines 26-33). Biing-Jye et al. disclose a similar light-emitting structure constructed by Group III-V compound. Biing-Jye teaches the III-V family semiconductor has the highest energy bandgap and suitable for short wavelength, high efficiency device (Biing-Jye col. 1, lines 7-11). Therefore, it would have been obvious to one with ordinary skill in the art to modify Schetzina's device with the teaching of Biing-Jye to construct a light-emitting structure of Group III-V compounds in order to produce a high efficiency light-emitting device. The Group III-V semiconductor compound would include the InGaP or InAlGaP.

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) modified by Biing-Jye et al. (US 6,169,294) as applied to claim 3 above, and further in view of Takahashi et al. (US 5,360,762).

With regard to claim 17, in addition to the limitation disclosed in claims 1-14 above, Schetzina modified by Biing-Jye et al. also disclose:

- Schetzina modified by Biing-Jye et al. discloses a contact layer formed on the double-heterostructure, but do not disclose a recessed surface on the contact layer. However, Takahashi et al. disclose a light-emitting device having a groove (recess) formed in the double-heterostructure and the cap (contact) layer 42 forms a recess (Takahashi fig. 6d). Takahashi et al. teach the recess can reduce the optical absorption loss and have a low threshold current. Therefore, it would have been obvious to one with ordinary skill in the art to modify Schetzina's device with the teaching of Takahashi et al. to have a recess in the heterostructure in order to reduce the optical absorption loss and have a low threshold current.
- Schetzina modified by Takahashi et al. above would have a recess on the contact layer, but Schetzina does not disclose the top electrode 102 is a light-reflecting electrode. However, electrode 13 and electrode 102 are formed by same material, ITO. Therefore, electrode 13 is a light-reflecting electrode and electrode 102 could also be light reflective. This is merely a design choice.

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) in view of Bour et al. (US 5,977,612).

With regard to claim 20, Schetzina does not disclose the shape of the light-emitting element is a polygonal prism having at least five corners or a circular cylinder. However, Bour et al. disclose a cylindrical LED on a hexagonal crystallite structure 200 and a circular light-emitting element 202 (Bour fig. 2a & 2b). Bour et al. teach the conventional LED structures require a separation between LED structures (Bour col. 2, lines 1-4), but an array of crystallites could be formed in a single substrate (Bour col. 3, lines 1-15) by taking advantage of the natural lattice structure of III-V compound (Bour col. 2, line 48-60). Therefore, it would have been obvious to one with ordinary skill in the art to modify Schetzina's device with the teaching of Bour to have a hexagonal or cylindrical light-emitting structure in order to form a high-density integrated device.

Claims 21-23 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) in view of Suzuki et al. (US 5,253,264).

With regard to claims 21 and 22, Schetzina does not disclose a photonic crystal layer on at least one surface of the light-emitting layer. However, Suzuki et al. disclose an integrated LED device having a diffraction grating formed on the uppermost InGaAsP layer 3b of the multiple quantum well (Suzuki col. 15, lines 34-39 and fig. 4). Suzuki et al. teach the LED device would integrate with other optical semiconductor device to form a photonic integrated circuit (Suzuki col. 14, line 66 to col. 15, line 10). Therefore, it would have been obvious to one with ordinary skill in the art to modify Schetzina's device with the teaching of Suzuki et al. to include the

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diffraction grating in the photonic crystal layer 3b in order to form an integrated optical semiconductor device. Suzuki et al. do not disclose which direction the diffraction grating is formed. However, one with ordinary skill in the art could form the photonic element in same direction of the light-emitting layer or opposite direction.

With regard to claim 23, Schetzina modified by Suzuki et al. in claim 21 above, would disclose a dislocation occurred near the side surface of the active layer 4 (Suzuki col. 2, lines 51-60), which is a diffractive grating to allow light exists the active layer.

With regard to claims 26 and 27, in addition to limitation disclosed in claim 1-2 and 21-23 above, Schetzina also discloses:

- Schetzina modified by Suzuki et al. disclose at least one light-emitting layer formed on each of the two surface of the diffraction grating (Suzuki col. 23, lines 18-40 and fig. 14 and 15). The wavelength is 1.52-1.57  $\mu\text{m}$  (Suzuki col. 23, lines 54-65).
- Schetzina modified by Suzuki et al. disclose a Bragg reflective layer could be formed (Suzuki col. 14, lines 56-65).

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,351,255) in view of Paoli et al. (US 5,138,625).

With regard to claim 24, in addition to limitation disclosed in claim 1-2, 14, and 17 above, Schetzina also discloses:

- Schetzina does not disclose an interface of the contact layer in contact with the first cladding layer is corrugated to have a gradient index and light emitted by the



light-emitting layer is reflected by the interface. However, Paoli et al. disclose a LED having a corrugated interface between the contact layer 300 and cladding layer 296 (Paoli col. 12, lines 7-41 and fig. 12). Paoli et al. teach the V-groove of the corrugated interface polarizes the light beam parallel to the plane of incidence (Paoli col. 6, lines 1-9 and col. 12, lines 1-18). Therefore, it would have been obvious to one with ordinary skill in the art to modify Schetzina's device with the teaching of Paoli et al. to provide a corrugated interface between the contact layer and cladding layer. Doing so would control the polarization of the light emission.<sup>4</sup>

#### *Allowable Subject Matter*

Claim 25 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

#### *Response to Arguments*

Applicant's arguments filed 10/11/02 have been fully considered but they are not persuasive.

- Applicant argues that the bonding layer 106 is formed of conducting epoxy, which has a high thermal resistance, and thus cannot reduce thermal strain of the

active layer. If the bonding layer 106 is formed of solder, the solder is stiff and causes crystal defects in other layers. However, the bonding made of solder meets the amended claim limitation. Whether the solder could cause defect in other layers is not in the claimed limitation in claim 1.

- Applicant argues Biing-Jye does not disclose the intermediate layer. However, Biing-Jye includes a solder layer, which meets the claim limitation.
- Applicant argues that Bour et al. disclose a laser diode that extracts light from only the top substrate and do not extract light from the end surface. Neither Schetzina nor Bour et al. disclose or suggest a light-emitting layer having a shape that is a polygonal prism having at least five corners or a circular cylinder. However, Bour et al. disclose a light-emitting element, which is circular in shape (Bour fig. 2b). The portion where extracting light from the end surface is not in claim 20.

- Applicant argues that Suzuki et al. do not disclose a photonic crystal layer. However, in page 24 of the specification,

“photonic crystal is based on the bandgap. Since the bandgap does not permit any optical state, light having a photon energy corresponding to the bandgap cannot exit in the crystal. This realizes the light confinement effect and waveguide.”

The layer 3b is a waveguide in Suzuki’s device.

- Applicant argues that the groove in Paoli et al. does not extract light and cannot improve the light extraction efficiency. However, the ITO electrode would reflect light within the groove (see above rejection) and light extraction efficiency is not part of the claim.

*Conclusion*

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.

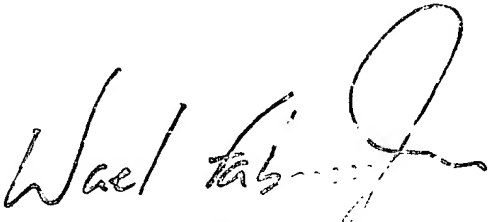
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

wsl

December 17, 2002



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